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GB 2220319 A EP 0541092 A

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# (54) Automatic image stabilizing system for a camcorder

(57) An automatic image stabilizing system for a camcorder which can automatically compensate for image shaking due to camera shake includes an A/D converter 25 for converting an input image signal into a digital signal, a memory 31 for storing the converted digital image signal, a motion vector detector 26, for detecting a motion vector by detecting edge values of adjacent pixels and selecting the maximum value among the detected edge values as a representative value, and a controller 29 receiving the motion vector signal and controlling the digital image signal stored in the memory to be compensated for when the detected motion is due to camera shake rather than panning. The zooming processor 32 ensures that only motion-compensated image portions are displayed.

FIG. 6

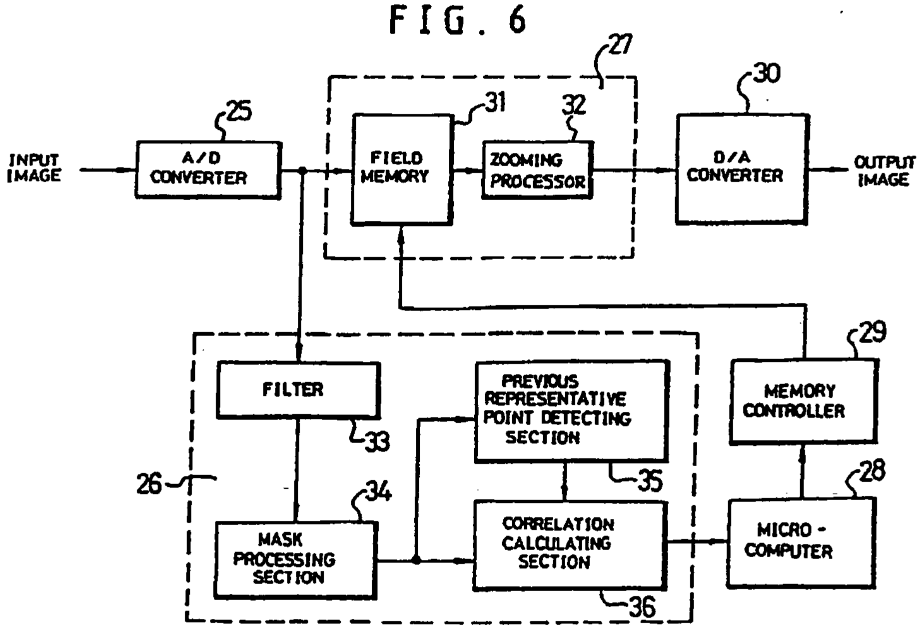


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FIG. 1 (PRIOR ART)

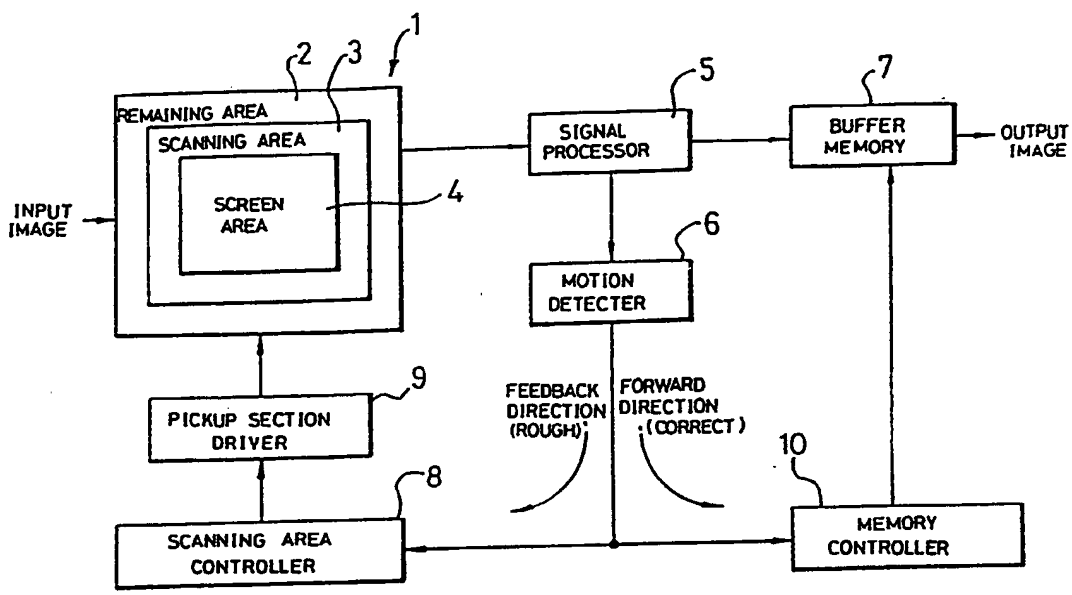



FIG. 2

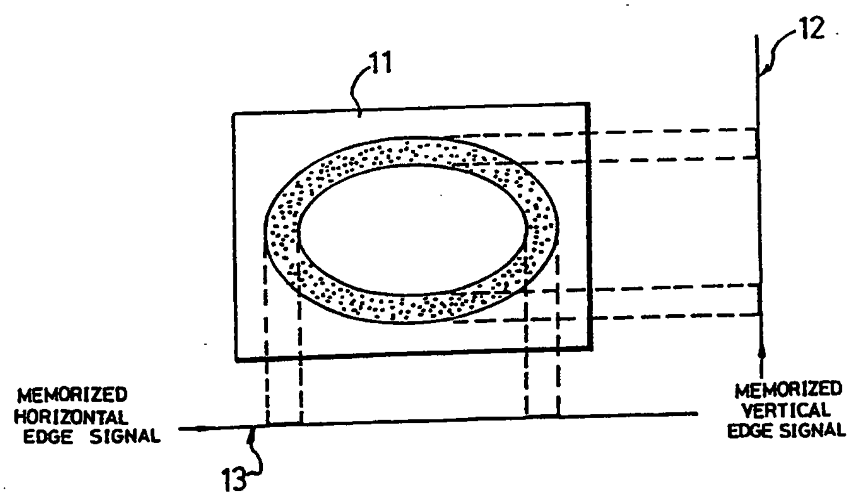


FIG. 3 (PRIOR ART)

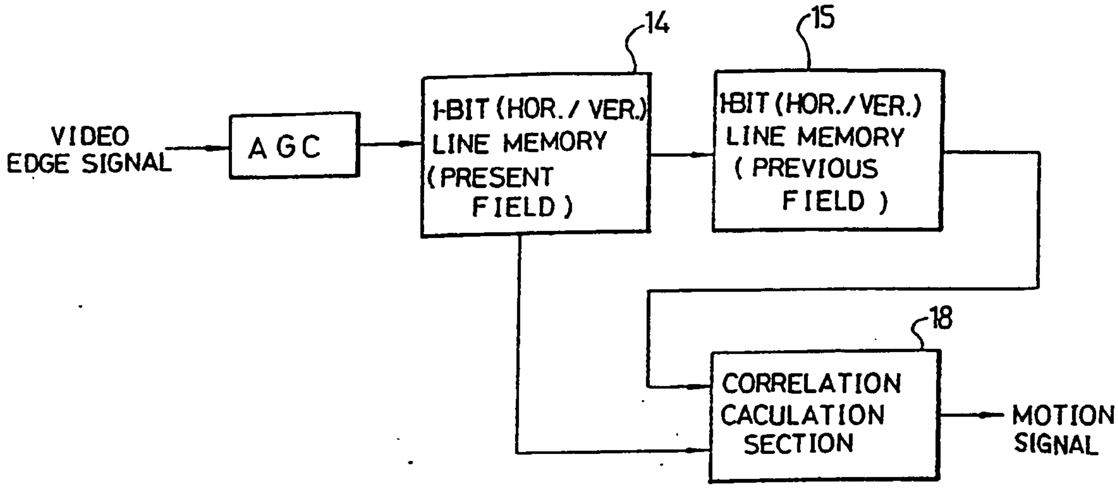



FIG. 4 (PRIOR ART)

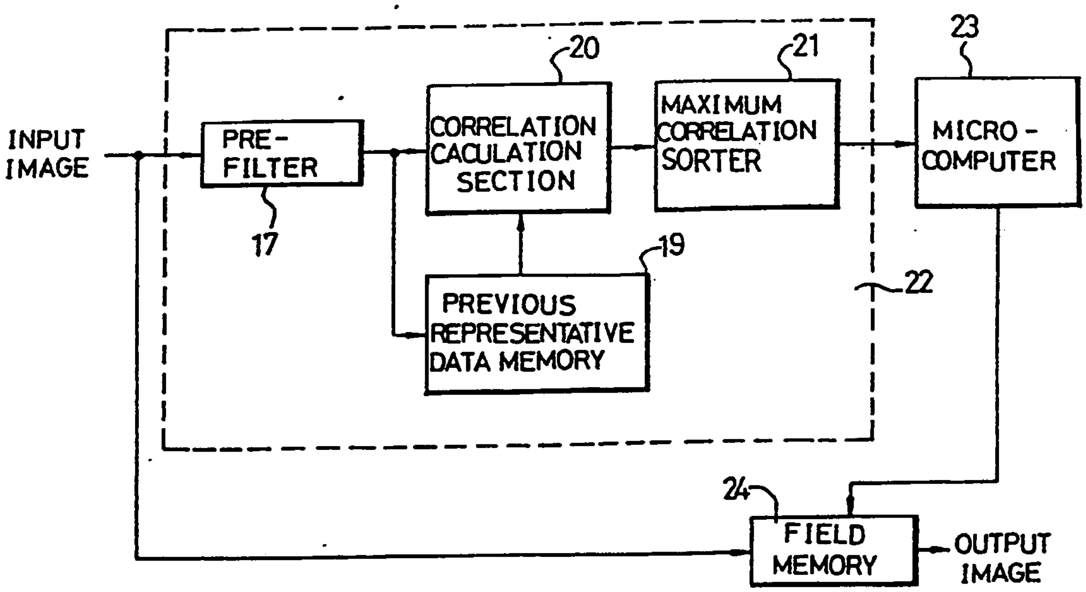


FIG. 5A

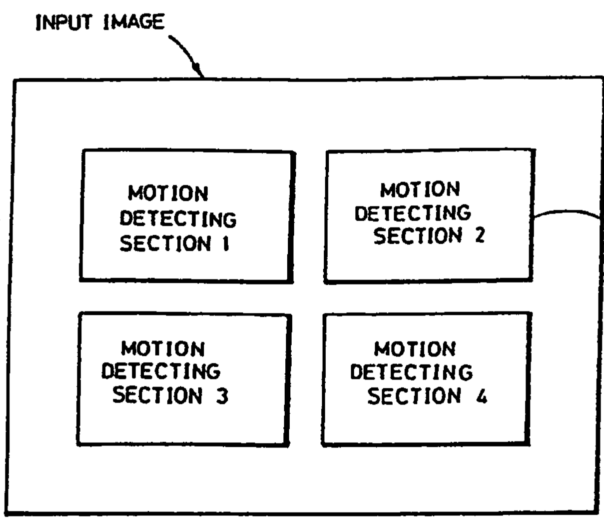



FIG. 5B

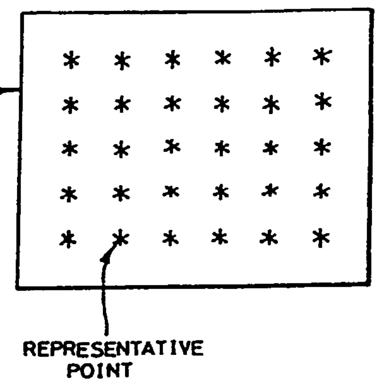



FIG. 6

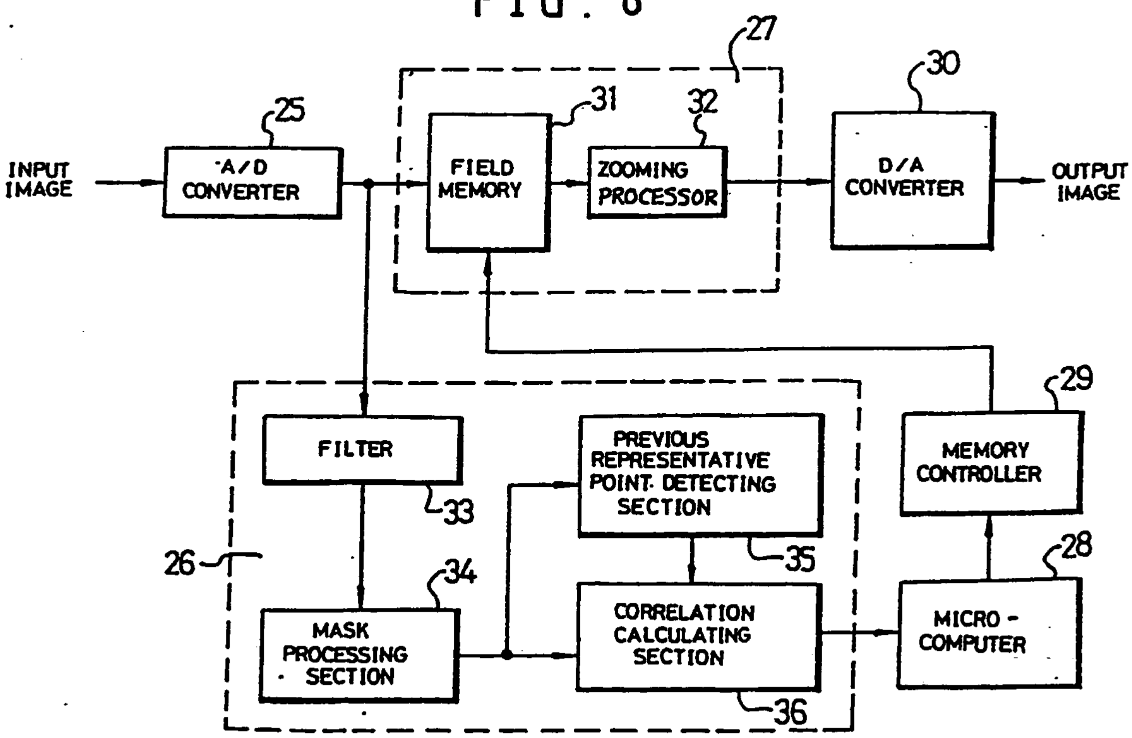


FIG. 7A

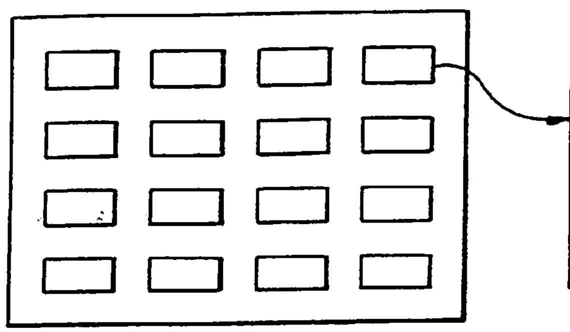


FIG. 7B

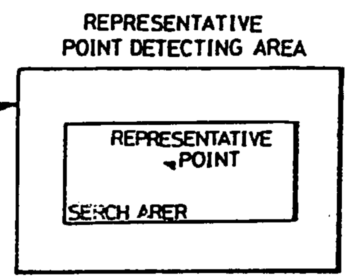



FIG. 8

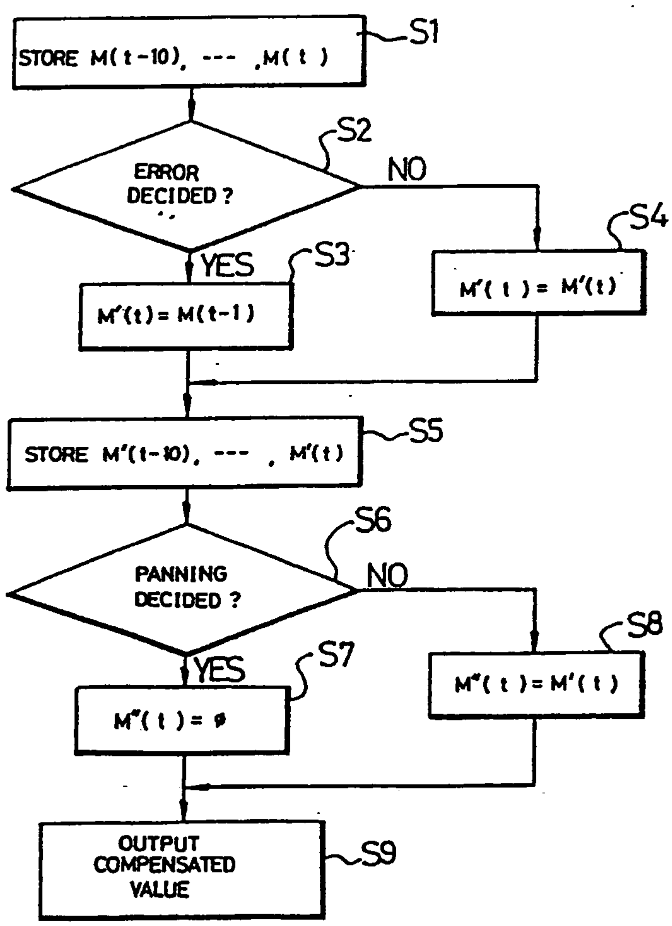
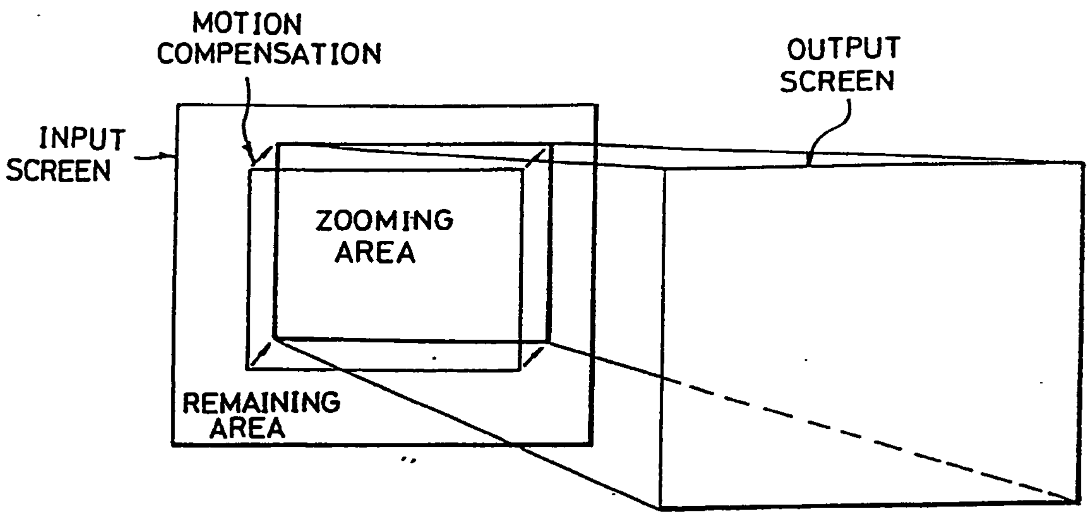


FIG. 9


MOTION
COMPENSATION
OUTPUT
SCREEN
INPUT
SCREEN
ZOOMING
AREA
REMAINING
AREA

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# AUTOMATIC IMAGE STABILIZING SYSTEM FOR A CAMCORDER

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention generally relates to a camcorder, and more particularly to an automatic image stabilizing system for a camcorder which can automatically compensate for image shaking due to a user's hands tremble during photographing.

### 2. Description of the Prior Art

A conventional dual image stabilizer for a camcorder is shown in FIG. 1. The stabilizer is provided with an image pickup section,which is divided into a screen area 4, a scanning area 3 and a remaining area 2, for picking up the image signal for the scanning area 3, a signal processor 5 for processing the output signal of the pickup section 1, a motion detector for detecting motion of images from the output signal of the signal processor 5 and outputting the detected motion signal in forward and feedback directions, and a buffer memory 7, connected to the output of the signal processor 5, for storing the image signal for the scanning area 3. The stabilizer is also provided with a scanning area controller 8 receiving the motion signal in the feedback direction from the motion detector 6 and controlling the scanning area 3, a pickup section driver 9 for performing brief motion-compensation by changing the scanning area 3 under the control of the scanning area controller 8, and a memory controller 10 receiving the motion signals in the forward direction from the motion detector 6 and controlling the buffer memory 7 to compensate for the image signal for the scanning area stored in the buffer memory 7.

The operation of the conventional stabilizer constructed as above is hereinafter explained.

First, the image signals for the scanning area 3 outputted from the image pickup section 1 is processed by the signal processor 5 and then is stored in the buffer memory 7.

At the same time, the motion detector 6 receives the output of the signal processor 5 and performs a correlation calculation in order to detect the motion of images. According to the correlation calculation, two-dimensional vertical and horizontal edge signals 12 and 13 of the image are projected and reduced to one-dimensional edge data, respectively, as shown in FIG. 2 showing an image pickup device 11, and the respective edge data are stored in a one-bit line memory 14 as shown in FIG. 3 showing the detailed structure of the motion detector 6.

Also, the reduced edge data is outputted from the line memory 14 and then stored in another one-bit line memory 15, being delayed for one field, as a previous field data and another edge data is stored in the line memory 14 as a present field data. The motion can be detected by calculating the correlation between the present field data from the line memory 14 and the previous field data from the line memory 15 through a correlation calculating section 16.

The motion signal obtained as described above is then inputted to the memory controller 10, and accordingly, the memory controller 10 selects the row and column addresses of the buffer memory 7 storing the image signal for the scanning area for compensation for the detected value of motion, resulting in that the stabilized image signal is outputted therefrom.

Meanwhile, FIG. 4 shows another conventional image stabilizer

system. This stabilizer system is provided with a motion detector 22 which comprises a pre-filter 17 for extracting the band components of an input image signal, a previous representative data memory 19 for storing the motion data between each field, a correlation calculating section 20 for calculating the correlation between the outputs of the pre-filter 17 and the previous representative data memory 19, and a maximum correlation sorter 21, connected to the output of the correlation calculating section 20, for detecting motions in four quadrants of a field.

The stabilizer system is also provided with a microcomputer 23 for receiving the motion signals outputted from the motion detector 22 and selecting one of the motion signals which best represents the movement of a video camera, and a field memory 24 for compensating the input image signal for the image motion under the control of the microcomputer 23.

Now, the operation of the conventional stabilizer system constructed as above is explained.

The input image signal is supplied to the motion detector 22 and to the field memory 24, respectively. In the motion detector 22, the image signal passes through the pre-filter 17 which acts as a band component extracting filter and the image motion between each field is then calculated utilizing a representative point matching technique.

The pre-filter 17 is composed of a low-pass filter connected in series for suppressing unnecessary high frequency components from the image and noise signals and a high-pass filter for image compensation.

Also, the representative point matching calculation is

performed by storing the image data at the positions of 30 predetermined representative points per quadrant as shown in FIGs. 5A and 5B, with respect to the image signal for one field inputted to the previous representative data memory 22.

The respective motion values for the four quadrants are detected by the correlation calculating section 20 and the maximum correlation sorter 21 in accordance with the correlation between the representative values of a previous field and the image signal values of a present field, and the detected motion values are inputted to the microcomputer 23. Accordingly, the microcomputer 23 selects one of the four inputted motion values which best represents the movement of the video camera and controls selection of the addresses of the image data values stored in the field memory 24 according to the selected motion value, so that the motion-compensated stabilized image data is outputted from the field memory 24.

However, such conventional motion compensating systems have the drawbacks as follows:

First, in order to more accurately detect motion vectors, a greatly complicated hardware is required, and if the hardware construction is simple, incorrect motion vectors may be detected. For example, the conventional stabilizer system as described above may detect motions somewhat accurately, however, a large amount of hardware is required to calculate the correlation between each of 120 representative points.

Second, since the correlation is calculated with the data at the fixed representative points, it is liable to miss the points having more accurate image information.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an image stabilizing system which can accurately detect the motion of image by selecting 16 variable representative points.

In order to achieve the above object, the image stabilizing system according to the present invention comprises:

analog/digital conversion means for converting an input image signal into a digital image signal;

memory and zooming means for storing said digital image signal and performing zooming process with respect to said digital image signal;

motion vector detecting means for detecting a motion vector by detecting edge values of adjacent pixels and selecting the maximum edge value among the detected edge values as a representative value; and

control means for determining whether a detected motion is due to a user's hands tremble or panning of a video camera in accordance with said motion vector detected by said motion vector detecting means, and controlling said digital image signal stored in said memory and zooming means to be compensated for when said detected motion is determined due to the user's hands tremble.

## BRIEF DESCRIPTION OF THE DRAWINGS

The above object and other features and advantages of the present invention will become more apparent by describing the preferred embodiment thereof with reference to the accompanying drawings, in which:

FIG. 1 is a schematic block diagram of the conventional dual

image stabilizer.

FIG. 2 is a view explaining projection of image signal.

FIG. 3 is a schematic block diagram of the conventional motion detector in FIG. 1.

FIG. 4 is a schematic block diagram of another conventional image stabilizer system.

FIG. 5 is a view explaining motion vector detecting areas.

FIG. 6 is a schematic block diagram of an automatic image stabilizing system according to the present invention.

FIGs. 7A and 7B are views explaining a representative point detecting area and a search area for detecting a motion vector according to the present invention.

FIG. 8 is an algorithm diagram explaining the operation of the present invention.

FIG. 9 is a view explaining a zooming process according to the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 6, one embodiment of the automatic image stabilizing system according to the present invention is illustrated. The present image stabilizing system is provided with an analog/digital (A/D) converter 25 for converting an input image signal into a digital image data, a motion vector detector 26 for detecting a motion vector from the digital image data from the A/D converter 25, and a memory and zooming section 27 for storing the digital image data and performing zooming process with respect to the digital image data. The system is also provided with a microcomputer 28 for outputting a control signal in accordance with

the motion vector information from the motion vector detector 26, a memory controller 29 for controlling selection of the addresses of the digital image data stored in the memory and zooming section 27 in accordance with the control signal inputted from the microcomputer 28, and a digital/analog (D/A) converter 30 for converting the digital image data outputted from the memory and zooming section 27 into an analog image signal.

In the embodiment, the memory and zooming section 27 is composed of a field memory 31 for storing the digital image data, and a zooming processor 32 for performing digital zooming process with respect to the digital image data stored in the field memory 31 so as to zoom only the motion-compensated image portions to be outputted and displayed over the whole display screen.

Meanwhile, the motion vector detector 26 is composed of a filter 33 for removing a noise from the digital image signal from the A/D converter 25, a mask processing section 34 for performing masking process in a specific form in order to detect an edge between two adjacent areas, a previous representative point detecting section 35, connected to the mask processing section 34, for determining the representative value for motion detection, and a correlation calculating section 36 for calculating the correlation between the outputs of the mask processing section 34 and the previous representative point detecting section 35 to output a motion information.

Hereinafter, the operation and the effect of the image stabilizing system according to the present invention constructed as above will be described in detail.

The input image signal is converted into a digital image

signal through the A/D converter 25 and the converted digital image signal is then stored in the field memory 31 of the memory and zooming section 27 as well as passes through the filter 33 of the motion vector detector 26 for the removal of noise.

The filter 33 is a kind of low-pass filter adopting the average filter principle. That is, the average filter coefficient matrix with respect to the area of 3 x 3 is

$$\begin{vmatrix} f_{1,1} & f_{2,1} & f_{3,1} \\ f_{1,2} & f_{2,2} & f_{3,2} \\ f_{1,3} & f_{2,3} & f_{3,3} \end{vmatrix} = \begin{vmatrix} 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \end{vmatrix}$$

The central pixel value in a new outputted image matrix is

$$(f_{1,1} \times P_{1,1}) + (f_{2,1} \times P_{2,1}) + \ldots + (f_{3,3} \times P_{3,3})$$

where $f_{i,j}$ is a coefficient matrix and $P_{i,j}$ is an input image data.

The image data outputted from the filter 33 is inputted to the mask processing section 34 and passes through a mask of a specific form to obtain a representative point value. Thus, the mask processing section 34 outputs a resultant edge which is an important information to detect the representative point in each defined area as shown in FIG. 7. The value resulting from adding the adjacent pixel values in the horizontal and vertical directions to the luminance difference value is determined as an edge value.

The edge value obtained as described above is inputted to the previous representative point detecting section 35 and used to determine the representative point value for detecting the motion. For example, as shown in FIG. 7A, the point having the largest edge value in the 16 divisional areas of the input image is determined as the representative point. The spaces between the 16 divisional areas are for preventing data redundancy between

adjacent portions thereof during a search for motion detection.

The representative point of the previous screen outputted from the previous representative point detecting section 35 and the edge data of the present screen outputted from the mask processing section 34 are inputted to the correlation calculating section 36, and as shown in FIG. 7B, the correlation between the representative point and the edge value of a search area around each of the 16 representative points is calculated by the correlation calculating section 36. The calculated correlation values with respect to the 16 divisional areas are added and the resultant least position vector is outputted to the microcomputer 28 as a motion information.

Now, the operation of the microcomputer 28 is explained with reference to FIG. 8.

At step S1, the motion value (i,j) which is the motion vector obtained by utilizing the correlation between each representative point detected by the motion vector detector 26 is stored as the motion information extracted from 10 frames.

At step S2, it is discriminated whether the detected motion information is correct or incorrect. If the detected information is discriminated incorrect, the motion value of the present frame is determined as that of the previous frame at step S3, while if the detected information is correct, the motion value of the present frame is determined as the detected motion value at step S4.

At step S5, with respect to each of the 10 motion vectors determined and then stored at steps S3 and S4, panning discrimination is performed. If the motion is due to the user's

panning of the video camera, the motion vector value is set to "0" at step S7, while if the motion is due to the user's hands tremble, the motion vector value is set to the detected value at step 8.

At step S9, the image is integrated according to the motion vector value set by the panning discrimination and then compensated for so that the image is centered on the display screen.

Accordingly, the microcomputer 28 outputs the compensated value to the memory controller 29 and the memory controller 29 controls the positions of the addresses of the field memory 31 according to the compensated value.

The zooming processor 32 performs digital zooming process with respect to the image data outputted from the field memory 31 so that only the motion-compensated image portions are outputted and displayed over the whole display screen. The zoomed image data from the zooming processor 32 is converted into an analog image signal by the D/A converter 30.

From the foregoing, according to the present invention, more accurate motion information can be detected with its simple hardware construction, and thus can compensate for the shaking image due to the user's hands tremble and provide a stabilized image.

What is claimed is:

1. An image stabilizing system for a camcorder comprising:

analog/digital conversion means for converting an input image signal into a digital image signal;

memory and zooming means for storing said digital image signal and performing zooming process with respect to said digital image signal;

motion vector detecting means for detecting a motion vector by detecting edge values of adjacent pixels and selecting the maximum edge value among the detected edge values as a representative value; and

control means for determining whether a detected motion is due to a user's hands tremble or panning of a video camera in accordance with said motion vector detected by said motion vector detecting means, and controlling said digital image signal stored in said memory and zooming means to be compensated for when said detected motion is determined due to the user's hands tremble.

2. An image stabilizing system as claimed in claim 1, wherein said memory and zooming means comprises:

a field memory for storing said digital image signal from said analog/digital conversion means; and

a zooming processor for performing digital zooming process with respect to said digital image signal stored in said field memory so as to zoom only the motion-compensated image portions to be displayed over a whole display screen.

3. An image stabilizing system as claimed in claim 1, wherein said motion vector detecting means comprises:

a filter for removing a noise from said digital image signal

from said analog/digital conversion means;

mask processing means, connected to the output of said filter, for performing masking process in order to detect an edge between two adjacent areas;

previous representative point detecting means, connected to the output of said mask processing means, for determining a representative value for motion detection; and

correlation calculating means for calculating the correlation between the outputs of said mask processing means and said previous representative point detecting means to provide a motion information.

| Patents Act 1977<br>Examiner's report to the Comptroller under Section 17 -13-<br>(1 Search report) | Application number<br>GB 9326006.5 |
|---|---|
| **Relevant Technical Fields**<br><br>(i) UK Cl (Ed.M) H4F (FCC, FGXX, FHH, FGM, FESA)<br>(ii) Int Cl (Ed.5) H04N (5/14, 5/232) | Search Examiner<br>M J DIXON<br><br>Date of completion of Search<br>23 FEBRUARY 1994 |
| **Databases (see below)**<br>(i) UK Patent Office collections of GB, EP, WO and US patent specifications.<br><br>(ii) WPI ONLINE | Documents considered relevant following a search in respect of Claims :-<br>ALL |

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| Category | Identity of document and relevant passages | | Relevant to claim(s) |
|---|---|---|---|
| Y P | EP 0541092 A | (SANYO) 12 May 1993, see eg page 3, line 48 et seq | 1, 3 |
| Y | GB 2220319 A | (PLESSEY) see eg. page 4, lines 13-15 | 1, 3 |

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